Recent Trends in the Grand Manan Scallop Fishery

G. Robert, M.J. Lundy, and R.A. Chandler[1]

Fisheries Research Branch
Scotia-Fundy Region
Halifax Fisheries Research Laboratory
Department of Fisheries and Oceans
Halifax, N.S.
B3J 2S7

[1]Fisheries Research Branch
Scotia-Fundy Region
Biological Station
Department of Fisheries and Oceans
St. Andrews, N.B.
E0G 2X0

March 1984

Canadian Technical Report of Fisheries and Aquatic Sciences No. 1267

Canadian Technical Report of Fisheries and Aquatic Sciences

Technical reports contain scientific and technical information that contributes to existing knowledge but which is not normally appropriate for primary literature. Technical reports are directed primarily toward a worldwide audience and have an international distribution. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries and aquatic sciences.

Technical reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report is abstracted in *Aquatic Sciences and Fisheries Abstracts* and indexed in the Department's annual index to scientific and technical publications.

Numbers 1–456 in this series were issued as Technical Reports of the Fisheries Research Board of Canada. Numbers 457–714 were issued as Department of the Environment, Fisheries and Marine Service, Research and Development Directorate Technical Reports. Numbers 715–924 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Technical Reports. The current series name was changed with report number 925.

Technical reports are produced regionally but are numbered nationally. Requests for individual reports will be filled by the issuing establishment listed on the front cover and title page. Out-of-stock reports will be supplied for a fee by commercial agents.

Rapport technique canadien des sciences halieutiques et aquatiques

Les rapports techniques contiennent des renseignements scientifiques et techniques qui constituent une contribution aux connaissances actuelles, mais qui ne sont pas normalement appropriés pour la publication dans un journal scientifique. Les rapports techniques sont destinés essentiellement à un public international et ils sont distribués à cet échelon. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du ministère des Pêches et des Océans, c'est-à-dire les sciences halieutiques et aquatiques.

Les rapports techniques peuvent être cités comme des publications complètes. Le titre exact paraît au-dessus du résumé de chaque rapport. Les rapports techniques sont résumés dans la revue *Résumés des sciences aquatiques et halieutiques*, et ils sont classés dans l'index annual des publications scientifiques et techniques du Ministère.

Les numéros 1 à 456 de cette série ont été publiés à titre de rapports techniques de l'Office des recherches sur les pêcheries du Canada. Les numéros 457 à 714 sont parus à titre de rapports techniques de la Direction générale de la recherche et du développement, Service des pêches et de la mer, ministère de l'Environnement. Les numéros 715 à 924 ont été publiés à titre de rapports techniques du Service des pêches et de la mer, ministère des Pêches et de l'Environnement. Le nom actuel de la série a été établi lors de la parution du numéro 925.

Les rapports techniques sont produits à l'échelon régional, mais numérotés à l'échelon national. Les demandes de rapports seront satisfaites par l'établissement auteur dont le nom figure sur la couverture et la page du titre. Les rapports épuisés seront fournis contre rétribution par des agents commerciaux.

84- 2886 /

Canadian Technical Report of
Fisheries and Aquatic Sciences 1267

March 1984

RECENT TRENDS IN THE GRAND MANAN SCALLOP FISHERY

by

G. Robert, M.J. Lundy, and R.A. Chandler[1]

Fisheries Research Branch
Scotia-Fundy Region
Halifax Fisheries Research Laboratory
Department of Fisheries and Oceans
Halifax, N.S.
B3J 2S7

[1]Fisheries Research Branch
Scotia-Fundy Region
Biological Station
Department of Fisheries and Oceans
St. Andrews, N.B.
E0G 2X0

(c) Minister of Supply and Services Canada 1984

Cat. No. Fs 97-6/1267E ISSN 0706-6457

Correct citation for this publication:

Robert, G., M.J. Lundy, and R.A. Chandler. 1984. Recent trends in the Grand Manan scallop fishery. Can. Tech. Rep. Fish. Aquat. Sci. 1267: vii + 78 p.

CONTENTS

List of Tables. iv

List of Figures vi

Abstract. vii

Resume. viii

Introduction 1

Methods 1

Fishery data 1

Resource surveys 5

Results 11

Nature of the fishery 11

Participants 11

Recent management guidelines 17

History of landings 21

Fishery characteristics 43

Composition of catch 57

Resource surveys 57

Relative abundance of age-classes 57

Stock mortality rate estimates 61

Discussion 61

Fishery data 61

Survey data 71

Conclusions and summary 72

Acknowledgements 77

References 77

LIST OF TABLES

Table

1. Categories of vessels plying Bay of Fundy waters. By regulation, any vessel greater than 25.5 G.T. or longer than 14 m (45 ft) L.O.A. has to fill logs reporting daily fishing activities. Landings from vessels greater than 25.5 G.T. are recorded as "offshore" while inshore landings refer to vessels less than or equal to 25.5 G.T. 3

2. Number of vessels based in New Brunswick and carrying a Bay of Fundy scallop license from 1978 to 1982. A Bay of Fundy license entitles the holder to drag for scallops in the Bay of Fundy and other areas of NAFO Division 4X and, under special permit, in Subdivision 5Ze. Source: Licensing Unit, Fisheries and Oceans, Halifax. 13

3. Number of vessels carrying an "inshore" or "7-mile New Brunswick" license for the period 1978-1982. This license entitles the holder to fish within 7 nautical miles of the New Brunswick coast in the Bay of Fundy and the area defined as Lobster District 2 off Grand Manan Island. Source: Licensing Unit, Fisheries and Oceans, Halifax. 15

4. New Brunswick based vessels holding scallop licenses, (A) number supposed to fill logs reporting daily fishing activities by year; (B) number of vessels >25.5 G.T. which fished as evidenced by sales slips; (C) number of vessels >25.5 G.T. which filled at least one log record, (D) number of vessels >25.5 G.T. which provided complete effort data for at least one log. No logs were received from vessels belonging to Category 2. 19

5. Combined landings (t of scallop meats) by month - Statistical District 48 (Saint John). 23

6. Combined landings (t of scallop meats) by month - Statistical District 49 (Chance Harbour). 25

7. Combined landings (t of scallop meats) by month - Statistical District 50 (Grand Manan). 27

8. Combined landings (t of scallop meats) by month - Statistical District 51 (Deer Island, Campobello Island). 29

9. Combined landings (t of scallop meats) by month - Statistical District 52 (Back Bay, St. Andrews). 31

10. Combined landings (t of scallop meats) by month - Statistical District 53 (Beaver Harbour, Black's Harbour). 33

Table

11. Annual landings (t of scallop meats) by statistical district, by vessel tonnage, (1): ≤25.5 G.T.; (2): >25.5 G.T. Prior to 1967, landings were not divided by vessel tonnage. Source: Statistics Division, Fisheries and Oceans, Halifax. 35

12. 1980 monthly landings (t of scallop meats) by statistical district and by vessel size. For statistical purposes, landings from vessels ≤25.5 G.T. are classified as "inshore" and landings from vessels >25.5 G.T. as "offshore." Source: Statistics Division, Fisheries and Oceans, Halifax. 37

13. 1981 monthly landings (t of scallop meats) by statistical district and by vessel size. For statistical purposes, landings from vessels ≤25.5 G.T. are classified as "inshore" and landings from vessels >25.5 G.T. as "offshore." Source: Statistics Division, Fisheries and Oceans, Halifax. 39

14. 1982 monthly landings (t of scallop meats) by statistical district and by vessel size. For statistical purposes, landings from vessels ≤25.5 G.T. are classified as "inshore" and landings from vessels >25.5 G.T. as "offshore." Source: Statistics Division, Fisheries and Oceans, Halifax. 41

15. Ratios (%) of catches from log records and from sales slips (offshore and inshore landings) of Districts 50, 51, 52, and 53 for 1981 and 1982 (t of scallop meats) (cf. Table 11). 45

16. Fishery characteristics around Grand Manan Island by area in 1981. 47

17. Fishery characteristics around Grand Manan Island by area in 1982. 49

18. Fishery characteristics of Campobello and Deer Islands and Passamaquoddy Bay in 1981 and 1982. 51

19. Percent of the total Class 1 catch and CPUE (kg/hm) from the ten most productive areas in 1981 and 1982 as reported in log records. 53

20. Summary of fishing characteristics. Effort pertaining to logged catch and total offshore effort are prorated according to the effort which generated Class 1 catch. Prorating for total offshore effort is possible as only vessels greater than 25.5 G.T. provided log information. 55

Table

21. Number of research survey stations N by year and by area, average number of scallops per tow n (standard deviation) for unlined/lined gear. 63

22. Average scallop catch at age per tow for a 4-gang Digby drag inside the 7-mile line for lined middle buckets and unlined outside buckets. In 1979, catches from lined and unlined buckets were measured together. 65

23. Average scallop catch per tow by age grouping in each area by year. Abundance of recruits (age 4+ yr) was estimated from the catch of an unlined gear, while prerecruits (1-3 yr inclusive) abundance was estimated from the catch of a lined gear. 67

24. Mortality (Z) rate estimates from the age distribution of survey results. 69

LIST OF FIGURES

Figure

1. Grand Manan Island and its fisheries management zone. The light-shaded area corresponding to waters ≤40 fm (73 m) outlines the inside 7-mile area. The dark-shaded area with depths >40 fm illustrates the remaining portion of Lobster District 2, the outside 7-mile area. Map reproduced with kind permission of Campbell and Duggan (1980). 7

2. Grand Manan Island and surrounding areas with some reference points. The sample sites illustrated are representative of the coverage of research cruises, here the 1981 survey. 9

3. Histograms of shell samples (shell height classes in mm) from fishing vessels operating in different areas near Grand Manan in 1981. A: Yellow Ledge, 300481; B: 7 miles southwest of Gannet Rock, 270581; C: Gannet Rock, 270581; D: Gannet Rock, 180681; E: Southwest Bank, 280581. 59

4. Yield isopleths in g of meat per recruit according to the Thompson and Bell yield model for the area inside 7 miles with an oval of probable yield values in 1981. 73

5. Yield isopleths in g of meat per recruit according to the Thompson and Bell yield model for the area outside the 7-mile line. 75

ABSTRACT

Robert, G., M.J. Lundy, and R.A. Chandler. 1984. Recent trends in the Grand Manan scallop fishery. Can. Tech. Rep. Fish. Aquat. Sci. 1267: vii + 78 p.

Up to recently, the scallop fishery in southwest New Brunswick was not very important with a 20-yr mean annual landing of 8.6 t of scallop meats. A strong recruiting pulse brought drastic changes to the fishery in 1980 with well-above average landings for the area (164 t). Landings peaked at 561 t in 1981 to decline slightly in 1982 (294 t). Inshore vessels (≤25.5 G.T.) have been responsible for the majority of landings. Even though entry into the scallop fishery is limited there is a high number of scallop licenses, approximately 300, in the area. Scallop beds immediately surrounding Grand Manan have supported and continued to support the bulk of the fishery and with the highest catch-rates. Annual abundance indices from resource surveys reflected catch levels. Latest prerecruit indices are low, and it is doubtful that the high catch levels experienced recently could be maintained. Fishing patterns encountered (F=0.4-0.7 at age 5 scallops) yield less than optimal. Slightly greater fishing mortality rates (F>0.8) toward larger scallops (>age 7) would have far better yields.

RÉSUMÉ

Robert, G., M.J. Lundy, and R.A. Chandler. 1984. Recent trends in the Grand Manan scallop fishery. Can. Tech. Rep. Fish. Aquat. Sci. 1267: vii + 78 p.

Jusqu'à récemment la pêche du pétoncle n'était pas très importante dans le sud-ouest du Nouveau-Brunswick avec des débarquements annuels moyens de 8.6 t (poids de viande). Un fort recrutement a transformé cette pêche d'une façon soudaine en 1980 avec des débarquements supérieurs à la moyenne (164 t) pour la région. Les débarquements ont atteint des valeurs records en 1981 (561 t) pour diminuer légèrement en 1982 (294 t). Des bâteaux côtiers (≤25.5 G.T.) débarquent la majorité des prises. Bien que la participation à cette pêche soit limitée, le nombre de licenses pour la pêche au pétoncle est élevé, 300 approximativement. Les bancs de pétoncles dans le voisinage immédiat de Grand Manan ont soutenu et continuent de supporter le plus gros de la pêche et avec les taux de capture les plus élevés. Les indices annuels d'abondance d'après les inventaires de stocks réflètent les niveaux des prises. Les indices de prérecrues les plus récents sont bas et on doute fort que les hauts niveaux de prises réalisés récemment puissent être maintenus. Les pratiques de pêche couramment en usage (F=0.4-0.7 vers des pétoncles de 5 ans) procurent des rendements loin de l'optimum. Des taux de mortalité dûe à la pêche légèrement plus hauts (F>0.8) dirigés vers des pétoncles de plus grande taille (>age 7) fourniraient de fort meilleurs rendements.

INTRODUCTION

A small but long-standing scallop fishery off the Charlotte County coast of southwest New Brunswick was reported on in 1889 by W.F. Ganong. "In New Brunswick a schooner occasionally brings a quantity (of scallops) to Saint John from L'Etang Harbour or Mace's Bay where they were taken by dredges... The quantity sold is estimated to be about 200 bushels annually." Until 1920 Charlotte County was the only area within the Bay of Fundy that had a fairly regular fishery for scallops. With the discovery of scallop beds in Annapolis Basin in 1920, the Digby fishery was begun and took over the limelight with its expansion into the Bay of Fundy. Over the past 30 yr landings from New Brunswick have been approximately 5% of the Bay of Fundy scallop fishery. Since 1980 unusually high landings have been recorded which have increased the 20-yr average annual landing figure by almost seven times, from 8.6 t of scallop meats averaged annually during 1960-1979 to 58.7 t for the 1963-1982 period.

Such phenomenal catches were soon accompanied by resource surveys to investigate their origins.

These results and a description of the characteristics of this fishery and its participants are presented to explain the recent trends of the Grand Manan scallop fishery.

METHODS

FISHERY DATA

In the collection of landing statistics a distinction is made between landings of different sizes of vessels. Landings from vessels greater than 25.5 G.T. are defined as "offshore," regardless of the origin of the catch; landings from vessels less than or equal to 25.5 G.T. are termed "inshore." For ease of understanding, vessel types have been divided into four categories (Table 1).

By regulation any vessel greater than 25.5 G.T. or longer than 14 m (45 ft) has to keep a record of daily fishing activities through log keeping. Daily log records supply information on the nature of the catch, its origin, and fishing effort. When complete effort data are provided, Class 1 data, catch-rate estimates may be computed. Number of crew, width of gear, number of tows, and duration of tow are the main components of scallop fishing effort. Catches are often reported from a general area, e.g. Grand Manan Channel, and carry little valuable information on the nature of specific scallop beds. As is the case for other inshore fisheries, a shore reference point is often given to describe catch location, e.g. 2 miles from Prangle Point.

Table 1.- Categories of vessels plying Bay of Fundy waters. By regulation, any vessel greater than 25.5 G.T. or longer than 14 m (45') L.O.A. has to fill logs reporting daily fishing activities. Landings from vessels greater than 25.5 G.T. are recorded as 'offshore' while inshore landings refer to vessels less or equal to 25.5 G.T.

	≤25.5 G.T.	>25.5 G.T.
L.O.A. ≤14m (45')	1 no reporting; inshore	3 reporting; offshore
14m<L.O.A.<19.8m (45') (65')	2 reporting; inshore	4 reporting; offshore

RESOURCE SURVEYS

Resource surveys were first conducted in Grand Manan waters with an exploratory cruise of near inshore grounds in the fall of 1979. Subsequently, all survey work would be carried out either in September or October each year. Initially, survey design relied on information supplied by local fishermen and fishery officers for the identification of scallop beds, while lately (1981 and 1982) the distribution of the catch as obtained from log records has been used to randomly stratify the sampling in inshore and offshore waters (Fig. 1). Because of the management implications of the "7-mile line," and only 2 yr of catch-stratified data, survey stations have been clustered in two groups for analysis: 1) inside the 7-mile line; and 2) outside the 7-mile line. Grand Manan offshore waters included in the outside 7-mile group are: Northeast Bank, Southwest Bank, Seal Island, Grand Manan Channel, The Wolves, etc. (Fig. 2).

Scallop drags used throughout these surveys consisted of a four-gang 76.5 cm Digby drag, the two inside buckets lined with 38 mm stretch netting. Unlined drags catch more scallops than lined ones; for example, in 1980 61% versus 39%. However, lined drags catch more small scallops (<75 mm) (17% more in 1980) than unlined drags. This particularity of the gear has been examined previously for Bay of Fundy scallop stocks (Jamieson and Lundy, 1979) and in Northumberland Strait scallop stocks assessments (Jamieson et al., 1981). When individual bucket data are prorated to drag catch to provide catch values more typical of the commercial fishery, lined gear catch is used in prorating prerecruit (ages 1-3 yr) values while unlined gear is used to prorate recruit (age >3 yr) values.

Decca, then Loran C, navigation systems allowed precise calculation of location and distance covered during tows. Regardless of distance actually towed, analyses standardized scallop abundance to a tow distance of 800 m.

For each tow, data were recorded on the following: 1) shell height frequencies in 5-mm intervals for all live scallops and cluckers fished by each bucket; 2) Decca (1979) or Loran C bearings at start and end of tow; 3) depth (m); 4) compass bearing for direction of tow; 5) duration of tow in minutes; 6) substrate type; and 7) total volume estimated by the count of the number of vertical bucket rings which were covered by the catch.

Scallop age was inferred from shell height according to the von Bertalanffy growth parameters (H_∞=145.5 mm, K=0.24, t_o=0.8). (Shell height is the distance between the umbo and the farthest point on the ventral shell margin in a straight line.) Ages were obtained by analysis of "shell rings" of samples collected at the time of the surveys. Least squares

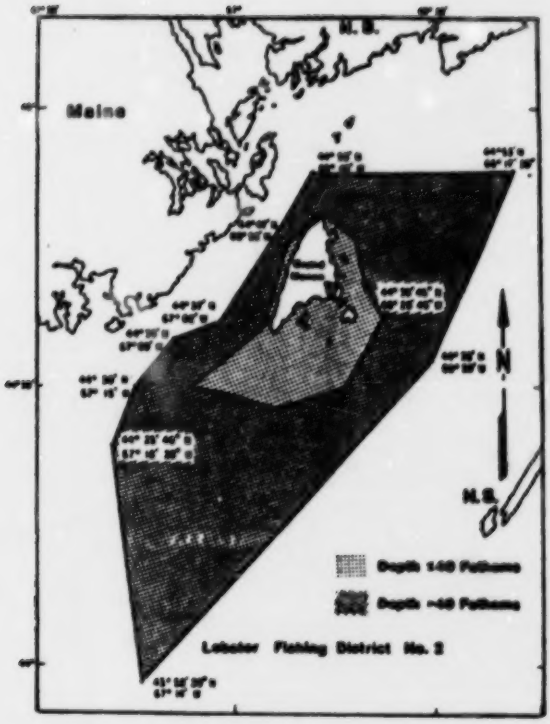

Figure 1.- Grand Manan Island and its fisheries management zone. The light-shaded area corresponding to waters ≤40fm (73m) outlines the inside 7-mile area. The dark-shaded area with depths >40fm illustrates the remaining portion of Lobster District 2, the outside 7-mile area. Map reproduced with kind permission of Campbell and Duggan (1980).

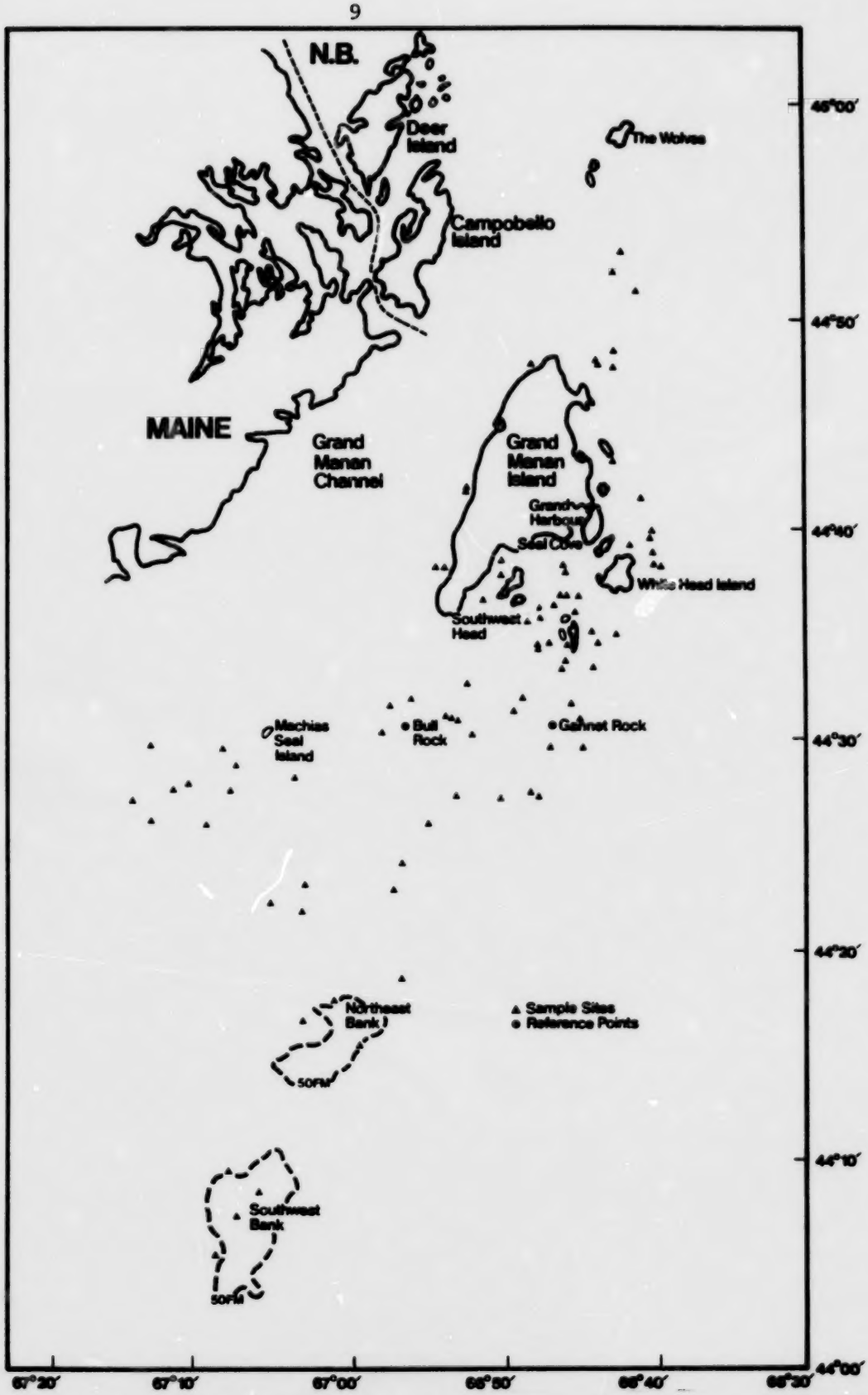

Figure 2.- Grand Manan Island and surrounding areas with some reference points. The sample sites illustrated are representative of the coverage of research cruises, here the 1981 survey.

regression techniques were used to determine adductor muscle weight (g) relative to shell height (mm). Since an analysis of variance indicated no statistical differences between the sets of allometric samples grouped by year, all data collected during the surveys 1979 to 1982 were pooled together. However, a difference is suspected between inshore and offshore waters even though not highly significant (likely attributable to the small number and relatively widespread geographic distribution of the offshore samples). This investigation should be pursued. In the meantime, the inshore area has been defined as: from Southwest Head on Grand Manan Island to 44°30'N lat., 67°20'W long., to 44°20'N, 67°00'W, to 44°40'N, 66°41'W, to 44°44'N, 66°43'W. Surrounding waters outside this area, The Wolves, Grand Manan Channel, Northeast Bank, Southwest Bank, eastern waters of Grand Manan, are, for the present purpose, classified as offshore. The resulting meat weight-shell height relationships are as follows: inshore Grand Manan waters n cases = 532.

$$\ln(\text{meat weight}) = -11.379 + 3.042 \ln(\text{shell height})$$

(Coefficient of determination = 0.906; 95% confidence interval of y-intercept -11.761 to -10.998, of regression coefficient 2.958 to 3.126.) Offshore Grand Manan waters n cases = 260.

$$\ln(\text{meat weight}) = -10.175 + 2.764 \ln(\text{shell height})$$

(Coefficient of determination = 0.788; 95% confidence interval of y-intercept -10.978 to -9.372, of regression coefficient 2.588 to 2.939.)

RESULTS

NATURE OF THE FISHERY

Participants

The vast majority of the Grand Manan scallop fleet are boats of the Cape Island design. They average 14 m (45 ft) in L.O.A. and are crewed by two or three men. They can readily change from one type of fishery to another, for example from lobster fishing, to scallop, to fish dragging. When scallop fishing, they usually tow 4-6 gang Digby-type drags from the starboard side where dumping boards are installed.

Scallop fishing is restricted to license holders. Grand Manan vessels carry a Bay of Fundy scallop license (Table 2) or an inshore or 7-mile New Brunswick license (Table 3). A Bay of Fundy scallop license entitles the holder to drag for scallops in the Bay of Fundy and other areas of NAFO Division 4X and, under special trip permit, in Subdivision 5Ze. A freeze has been imposed on the issuing of this type of license since 1973. The majority of Bay of Fundy licensed vessels operate from

Table 2.- Number of vessels based in New Brunswick and carrying a Bay of Fundy scallop license from 1978 to 1982. A Bay of Fundy license entitles the holder to drag for scallops in the Bay of Fundy and other areas of NAFO Division 4X and, under special permit in Subdivision 5Ze. Source: Licensing Unit, Fisheries and Oceans, Halifax.

	Vessel category				
Year	1	2	3	4	Total
1978	14	0	0	6	20
1979	13	0	0	7	20
1980	13	0	0	7	20
1981	14	0	0	6	20
1982	8	0	4	4	16

Table 3.- Number of vessels carrying an 'inshore' or 7-mile New Brunswick license for the period 1978-1982. This license entitles the holder to fish within 7 nautical miles of the New Brunswick coast in the Bay of Fundy and the area defined as Lobster District No. 2 off Grand Manan Island. Source: Licensing Unit, Fisheries and Oceans, Halifax.

	Vessel category				
Year	1	2	3	4	Total
1978	162	7	0	13	182
1979	1	0	0	1	(140)est.
1980	114	5	0	16	135
1981	239	13	0	38	290
1982	213	9	14	42	278

Digby, Nova Scotia, but a few operate from the New Brunswick side of the Bay, especially Grand Manan. The number of New Brunswick based Bay of Fundy licenses has remained fairly constant during the past 5 yr. These licenses are commonly bought and sold from one side of the Bay to the other, and slight shifts take place in the Bay of Fundy scallop fleet. In 1982, the Grand Manan area was left with 16 Bay of Fundy scallop licenses in comparison with previous years when it totalled 20.

Inshore licenses or 7-mile New Brunswick licenses entitle the holder to fish for scallops within 7 nautical miles of the New Brunswick coast in the Bay of Fundy and, since 1982, the area defined as Lobster District 2 off Grand Manan (Fig. 1). The number of inshore licenses fluctuate widely and has doubled from 1980 to 1981 to remain at this high level in 1982 (Table 3).

Not all scallop licenses are active. Some conservative estimates put at two-thirds the number of casual fishermen. Small, inshore vessels ($\leq$25.5 G.T.) often drag for scallops for their own use in addition to those fished for selling wholesale. Not all sales are reported, which makes the task of estimating the participation of inshore vessels difficult. Vessels greater than 25.5 G.T. are more likely to be actively involved in the fishery either year round or for the greater part of the fishing season. The number of such vessels holding a scallop fishing license has gradually and steadily increased since 1980 (Column A in Table 4), even though it appears that more than a few have not been fishing as no sales slips (records of transaction between fishermen and wholesale buyer) exist. A low participation rate is doubtful considering the relative abundance of scallop stocks in those waters lately and their high landed value. However, log reporting by vessels that fished, as evidenced by sales slips, was good (in 1981, 26 vessels out of 29; in 1982, 23 out of 26). Quality and completeness of the information supplied by log records could be improved (Column D in Table 4). Lately it has also deteriorated; in 1982 less than 50% of vessels actively participating in the fishery provided complete effort data for at least one log record.

Recent management guidelines

Besides gear restriction measures on minimum ring size (75 mm), total width (5.5 m), and limited entry into the fishery, the Grand Manan scallop fishery has few rules. There is, at present, no meat count regulation like is the case for scallop fishing areas such as Georges Bank.

Table 4.- New Brunswick based vessels holding scallop licenses, (A) number supposed to fill logs reporting daily fishing activities by year; (B) number of vessels >25.5 G.T. which fished as evidenced by sales slips; (C) number of vessels >25.5 G.T. which filled at least one log record; (D) number of vessels >25.5 G.T. which provided complete effort data for at least one log. No logs were received from vessels belonging to category no.2.

Year	A		B	C	D
	≤25.5	>25.5			
1980	5	23	N/A	N/A	N/A
1981	13	44	29	26	21
1982	9	64	26	23	12

Lately, a controversy arose because of the area restriction imposed by 7-mile inshore licenses. In late May 1981, lucrative scallop beds were discovered on Southwest Bank but these were out of bounds to the majority of Grand Manan scallop fishermen, by being farther offshore than 7 miles. Fishermen then requested that the scallop fishing area be enlarged to include the entire Lobster District 2 (Fig. 1) (this would include Southwest Bank). Independently of this issue, scallop fishermen had reached a "gentlemen's agreement" with lobster fishermen, that scallop dragging would not take place over the inshore beds (which are prime lobster grounds). (Scallop gear may damage lobster when overlap of the spatial and seasonal distribution of both scallop and lobster does occur). This agreement was eventually expanded to include all but the winter months thus working similarly to the 6-mile summer closure zone in the Digby, N.S., area. This agreement seriously reduced the area suitable for scallop dragging at certain times of the year. By early 1982 holders of inshore licenses were allowed in all of Lobster District 2 in addition to seasonal inshore grounds.

History of landings

The Grand Manan scallop fishery is of the inshore type and it has to be examined in the context of multispecies fisheries with lobster fishing, fish dragging, weirs, and longlining. Prior to mid-December 1979 when "3-ft deep" scallop beds were reported off Prangle Point, Grand Manan fishermen seemed to show little interest for scallop fishing in home waters probably because scallops were not plentiful. Combined (inshore and offshore) landings from 1974 onward for the New Brunswick Bay of Fundy coast (Tables 5-10) present a casual image of the scallop fishery. Catches have climbed drastically since 1980. Grand Manan Island landings hit record highs in 1981, followed distantly by Deer Island, Campobello Island, and Passamaquoddy Bay. 1982 figures remained high, although at a lower level. Long-term (20 yr) average annual landings for these areas are only 8.6 t (1960-1979) but jump to 58.7 t when the time period 1963-1982 is considered (Table 11). Since the bonanza took place, it is small inshore ($\leq$25.5 G.T.) vessels that land the most (Table 11; Tables 12-14) and principally on Grand Manan Island (Statistical District 50). Most of the fishing done by these small (<45'; $\leq$25.5 G.T.) vessels is in the vicinity of landing ports; therefore, landing statistics reflect in a coarse way the state of local scallop beds. Scallop meats are landed year round and there are no seasonal or monthly trends in landing patterns (Tables 12-14) except for relatively important landings in January-February 1980 when the exploitation of newly discovered scallop beds was initiated.

Table 5.- Combined landings (t of scallop meats) by month - Statistical District 48 (Saint John).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan.									
Feb.									
Mar.									
Apr.									
May									1.93
Jun.								0.18	0.96
Jul.								<0.1	0.24
Aug.									0.12
Sep.									0.12
Oct.									
Nov.									
Dec.									
Total								0.19	3.37

Source: Statistics Div., Fisheries and Oceans, Halifax. Scallop meat weight figures are obtained by dividing the round weight by the conversion factor 8.3.

Table 6.- Combined landings (t of scallop meats) by month - Statistical District 49 (Chance Harbour).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan.									
Feb.									0.24
Mar.								0.40	0.24
Apr.								1.22	0.12
May								<0.1	0.36
Jun.								0.17	0.96
Jul.									0.24
Aug.								0.27	0.12
Sep.								<0.1	0.48
Oct.							<0.1		0.84
Nov.									
Dec.									
Total							<0.1	2.12	3.60

Source: Statistics Div., Fisheries and Oceans, Halifax. Scallop meat weight figures are obtained by dividing the round weight by the conversion factor 8.3.

Table 7.- Combined landings (t of scallop meats) by month - Statistical District 50 (Grand Manan).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan.				0.32	0.43	<0.1	21.53	34.40	29.04
Feb.	0.70			1.45	2.18	4.62	13.05	48.09	39.64
Mar.	0.34	0.61	0.27	1.09	1.23	6.19	9.09	79.15	33.13
Apr.	0.23	0.11		0.14		1.89	3.32	42.77	3.25
May						0.79	1.65	76.45	6.87
Jun.								46.76	17.71
Jul.					1.27			63.66	39.04
Aug.					5.00		18.94	65.41	30.48
Sep.				<0.1			34.10	21.87	23.86
Oct.				0.39			28.53	7.35	15.30
Nov.							3.83	1.61	2.17
Dec.						11.12	11.23		0.48
Total	1.27	0.72	0.27	3.47	10.11	24.67	145.27	487.52	240.97

Source: Statistics Div., Fisheries and Oceans, Halifax. Scallop meat weight figures are obtained by dividing the round weight by the conversion factor 8.3.

Table 8.- Combined landings (t of scallop meats) by month - Statistical District 51 (Deer Island, Campobello Island).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan.	0.14			<0.1		0.67	1.83		0.72
Feb.	0.25	0.15	<0.1	<0.1		0.52	1.45	1.09	2.05
Mar.	0.39	0.57	0.20	<0.1		0.48	<0.1	2.29	1.81
Apr.	0.14	0.34	<0.1	<0.1		0.13	1.11	1.95	1.08
May		0.11	0.20	<0.1		<0.1	0.53	3.75	1.93
Jun.		<0.1	0.27				0.55	2.78	3.25
Jul.	<0.1	0.16	0.23				1.05	2.54	3.25
Aug.		0.20	0.20				0.30	3.02	1.33
Sep.	<0.1	0.23					0.47	3.66	2.65
Oct.		0.20	<0.1				1.16	28.52	1.33
Nov.		<0.1					<0.1	0.43	2.77
Dec.	0.23	0.11				0.18	0.54	0.43	0.12
Total	1.27	2.11	1.34	0.31		2.08	9.12	50.46	22.29

Source: Statistics Div., Fisheries and Oceans, Halifax. Scallop meat weight figures are obtained by dividing the round weight by the conversion factor 8.3.

Table 9.- Combined landings (t of scallop meats) by month - Statistical District 52 (Back Bay, St.Andrews).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan.								0.80	
Feb.							0.36	0.77	0.24
Mar.							0.67	0.91	3.49
Apr.							0.32	0.97	0.24
May							0.37	0.96	2.53
Jun.						<0.1	0.32	0.41	1.93
Jul.					0.14	0.42	2.29	2.89	3.25
Aug.					0.64	1.04	2.20	2.46	3.37
Sep.					0.59	1.36	1.66	1.32	4.22
Oct.				0.44	0.27	0.49	1.29	1.04	2.17
Nov.								1.78	0.96
Dec.								<0.1	
Total				0.44	1.64	3.36	9.48	14.31	22.40

Source: Statistics Div., Fisheries and Oceans, Halifax. Scallop meat weight figures are obtained by dividing the round weight by the conversion factor 8.3.

Table10.- Combined landings (t of scallop meats) by month - Statistical District 53 (Beaver Harbour, Black's Harbour).

	1974	1975	1976	1977	1978	1979	1980	1981	1982
Jan.	0.43	<0.1							
Feb.	0.61	0.15						1.93	
Mar.	0.16	0.22						4.78	0.12
Apr.	<0.1	<0.1						0.71	
May								<0.1	
Jun.									
Jul.								<0.1	0.24
Aug.	0.42	0.41							0.48
Sep.	0.43	0.23						0.39	0.48
Oct.	0.32								0.48
Nov.									
Dec.									
Total	2.44	1.13						7.97	1.80

Source: Statistics Div., Fisheries and Oceans, Halifax. Scallop meat weight figures are obtained by dividing the round weight by the conversion factor 8.3.

Table 11.- Annual landings (t of scallop meats) by statistical district, by vessel tonnage, (1): ≤25.5 G.T., (2): >25.5 G.T. Prior to 1967, landings were not divided by vessel tonnage. Source: Statistics Div., Fisheries and Oceans, Halifax.

District	48		49		50		51		52		53		Total
Tonnage	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1) + (2)
1960					2.8								2.8
1961					1.9								1.9
1962					4.2		5.5				3.8		13.6
1963					4.8		5.5				3.3		13.6
1964					0.8		4.7				2.4		8.0
1965	0.2				7.8		1.8				2.8		12.6
1966					0.9		0.9						1.8
1967							0.5			1.8	2.8		5.1
1968					14.5		2.3	1.3		0.5	1.8		20.4
1969											0.9		0.9
1970					7.7				1.3		1.3		10.4
1971					1.8		0.9		1.8		4.9		9.5
1972					1.8		0.5				3.6		5.9
1973					4.6		1.8				2.8		9.2
1974					1.3		1.3				2.4		5.1
1975					0.7		2.1				1.1		3.9
1976					0.2		1.3						1.6
1977					3.5		0.2		0.5				4.2
1978					3.9	6.3			1.7				11.8
1979					24.7		0.1	1.9	3.4				30.1
1980					137.7	7.5	5.3	3.7	6.6	2.9		0.2	164.0
1981		0.1	2.2		430.0	57.6	11.3	39.3	5.4	7.5	2.8	5.3	561.5
1982	3.1	0.4	3.1	0.4	197.0	43.6	10.8	11.2	14.8	7.8	1.8		294.2

Table 12.- 1980 monthly landings (t of scallop meats) by statistical district and by vessel size. For statistical purposes, landings from vessels ≤25.5 G.T. are classified as 'inshore' and landings from vessels >25.5 G.T. as 'offshore'. Source: Statistics Div., Fisheries and Oceans, Halifax.

	48		49		50		51		52		53	
	IN	OFF	IN	OFF	IN	OFF	IN	OFF	IN	OFF	IN	OFF
		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m
Jan					21.57		1.57	0.24				
Feb					13.01		1.20	0.24	0.36			
Mar					9.04							
Apr					3.37		0.24	0.84	0.12	0.12		
May					1.69		0.36	0.24	0.36			
Jun							0.48	0.12	0.24	0.12		
Jul							0.72	0.36	2.05	0.24		
Aug					17.83	1.08		0.24	1.69	0.48		
Sep					31.33	2.77	0.24	0.24	0.84	0.84		
Oct					27.23	1.33	0.36	0.72	0.24	0.96		
Nov					3.73	0.12	0.12					
Dec					9.04	2.17	0.12	0.48				
Total					**137.83**	**7.47**	**5.42**	**3.73**	**5.90**	**2.77**		

Table 13.- 1981 monthly landings (t of scallop meats) by statistical district and by vessel size. For statistical purposes, landings from vessels ≤25.5 G.T. are classified as 'inshore' and landings from vessels >25.5 G.T. as 'offshore'. Source: Statistics Div., Fisheries and Oceans, Halifax.

	48		49		50		51		52		53	
	IN	OFF	IN	OFF	IN	OFF	IN	OFF	IN	OFF	IN	OFF
		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m
Jan					33.49	0.84			0.36	0.36		
Feb					39.88	8.19	0.96	0.12		0.72		1.93
Mar		0.36			66.02	13.13	0.72	1.57		0.84	1.57	3.25
Apr		1.20			37.23	5.54	0.84	1.20	0.36	0.60	0.60	0.12
May					68.07	8.31	0.60	3.13	0.48	0.48	0.12	
Jun		0.12	0.12		44.34	2.41	0.96	1.81	0.24	0.12		
Jul					60.12	3.49	1.69	0.84	1.57	1.33		
Aug		0.24			54.70	10.72	1.57	1.45	1.33	1.08		
Sep					20.84	0.96	2.17	1.57	0.48	0.84	0.36	
Oct					5.18	2.05	1.33	27.23	0.24	0.84		
Nov						1.45	0.24	0.24	0.12			
Dec							0.24	0.12				
Total		**0.12**	**1.92**		**429.87**	**57.09**	**11.32**	**39.28**	**5.18**	**7.21**	**2.65**	**5.30**

Table 14.- 1982 monthly landings (t of scallop meats) by statistical district and by vessel size. For statistical purposes, landings from vessels ≤25.5 G.T. are classified as 'inshore' and landings from vessels >25.5 G.T. as 'offshore'. Source: Statistics Div., Fisheries and Oceans, Halifax.

	48		49		50		51		52		53	
	IN	OFF	IN	OFF	IN	OFF	IN	OFF	IN	OFF	IN	OFF
		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m		≤14m >14m
Jan					25.66	0.12	3.25	0.24		0.48		
Feb		0.24			34.94	0.36	4.34	0.96		1.08 0.12		0.12
Mar		0.24			28.19	0.60	4.34	1.45		0.36 2.05		1.45 0.12
Apr					2.05	1.08	0.12	0.84		0.24		0.24
May	1.69	0.240.36			6.75		0.12	0.24		1.69 2.41		0.12
Jun	0.96	0.72		0.24	7.83		9.88	2.05		1.20 1.08		0.84
Jul	0.24	0.12		0.12	34.22		4.82	3.01		0.24 1.93 1.20		0.12 0.24
Aug	0.12	0.12			25.66		4.82	0.72		0.60 2.17 0.72		0.48 0.48
Sep	0.12	0.48			18.80	0.72	4.34	0.72	0.24	1.69 2.53 0.84		0.84 0.48
Oct		0.84			11.57	0.72	3.01	0.60		0.72 1.81 0.24		0.12 0.48
Nov					0.96		1.20			2.77 0.60 0.36		
Dec					0.48			0.12				
Total	3.13	0.243.12		0.36	197.11	3.52	40.24	10.95	0.24	11.07	14.70 3.36	4.33 1.80

Fishery characteristics

The fact that inshore vessels which do not fill logs land their catch in the proximity of the main scallop beds does not provide detailed information as to the productivity of specific beds, nor does it indicate fishing effort levels or catch-rates. One has to rely on the information given by log-filling offshore vessels. Differences may exist between fishing patterns and catch-rates of inshore and offshore vessels; however, the presently available data are not sufficient to allow for a distinction. Therefore, the combined catch/offshore catch is used as a prorating coefficient to evaluate total effort. Most of the catches as reported in logs also provided complete effort data as indicated by the high ratios of 1981 and 1982 (Table 15, % Class 1/logged); but only 48% (1981) and 38% (1982) of offshore catches were log-recorded which make for a poor completion rate. Since offshore catches amount to 20-22% of the total landings, measures of effort extrapolated from those have to be interpreted with caution.

Fishery characteristics of offshore vessels such as catch, effort, and catch-rate are presented by area for Grand Manan in 1981 (Table 16) and in 1982 (Table 17) and for Campobello and Deer Islands and Passamoquoddy Bay (Table 18). Scallop beds surrounding Grand Manan have supported the bulk of the fishery and with the highest catch-rates.

The ten most productive areas, according to log-supplied information, were near Grand Manan Island, more particularly waters within 7 miles of the Grand Manan shoreline (Table 19). While 58% of the total Class 1 catch came from the ten most productive areas in 1981, the same number of areas produced 69% of the total Class 1 catch in 1982 which make for highly localized fishing. Despite the lack of precision in identifying the areas of catch origin, many localities producing high yields in 1981, i.e. Murr and White Ledge, do not occupy top ranks in 1982 and are replaced, i.e. Gannet Rock (Table 19). Although the 1982 catch was superior to 1981, the 1982 average CPUE (weighted by catch) declined to 55% of the 1981 value.

A summary of fishery performance of offshore vessels is presented in Table 20. In 1982 total offshore landings declined to only 57% of the record 1981 offshore levels. Effort expanded by this component of the fleet also declined to an average 81% of 1981 values (77% days, 86% hours, 81% hm). Overall, catch-rates went down to an average value of 70% of the 1981 figures (74% kg/d, 67% kg/h, 70% kg/hm). A cautious extrapolation to the entire Grand Manan scallop fleet, assuming the inshore vessels operate in the same fashion as offshore vessels, estimates that 4,721 fishing days would have been spent on Grand Manan area scallop beds in 1981 and 3,334 days in 1982 (a drop of almost 30% from the previous year).

Table 15.- Ratios (%) of catches from log records and from sales slips (offshore and inshore landings) of Districts 50, 51, 52, and 53 for 1981 and 1982. (t of scallop meats) cf. Table 11.

	Offshore			
	Class 1 catch	Catch from logs	Landings	Total landings
1981	49.47	52.96	109.64	559.16
1982	22.76	24.06	62.65	287.23

	Offshore			
	% Class 1 / logged	% Class 1 / landed	% logged / landed	% offshore / total
1981	93	45	48	20
1982	95	36	38	22

Table 16.- Fishery characteristics around Grand Manan Island by area in 1981.

Area	Catch	Effort			CPUE		
	kg	days	hours	hour-meters	kg/d	kg/h	kg/hm
Breaker	491	4	24	128.3	123	20.4	3.83
Bull Rock	2439	12	59	278.4	203	41.4	8.71
CrossJack Ledges	94	1	5	17.3	94	20.7	5.42
Duck I. Sound	1473	17	68	328.3	87	21.8	4.49
Eastern Ledge	464	6	27	136.2	77	17.1	3.41
Grand Manan Chan	1778	28	258	1383.5	64	6.9	1.29
Green Island	1689	14	68	344.7	121	24.9	6.74
Gannet Rock	1310	11	52	258.1	119	25.0	5.08
Long Ledge	443	5	24	123.6	89	18.6	3.58
Murr Ledge	5212	29	121	644.9	180	43.1	8.08
Ox Head	99	4	9	48.0	25	11.0	2.06
Prangle Point	521	6	27	170.2	87	19.6	3.06
Southeast Break	3189	18	101	439.7	177	31.5	7.25
Southeast Ledge	1777	3	26	138.1	592	68.8	12.87
S.Ledge Shoal	882	8	35	159.1	110	25.3	5.54
Three Islands	360	3	17	62.9	120	21.8	5.72
Tinker Shoal	404	4	12	44.6	101	34.5	9.06
White Ledge	3694	17	15	77.3	217	77.6	14.56
White Horse	871	13	45	215.3	67	19.2	4.04
Western Ledge	532	4	23	107.7	133	23.3	4.94
Wallace Rocks	171	3	10	47.6	57	16.4	3.60
Yellow Ledge	449	2	9	45.3	225	52.8	9.91
2miles Yellow Led	1189	5	26	98.6	238	46.0	12.06
3 " " "	346	3	12	54.0	115	29.3	6.40
4 " " "	1812	10	36	195.7	181	50.8	9.26
Ledges	2368	17	72	357.0	139	32.8	6.63
442664	739	9	52	287.2	82	14.3	2.57
442665	1682	10	49	275.5	168	34.5	6.10
442670	306	4	7	32.6	77	37.6	8.46
443664	333	3	5	19.6	111	71.4	17.03
443665	284	2	2	9.8	142	121.7	29.04
Grand Manan offshore waters:							
Northeast Bank	920	2	25	130.6	460	37.6	7.05
Seal Island	3072	24	94	447.3	128	31.9	6.67
4miles Seal Island	91	1	10	45.7	91	9.1	1.99
6miles " "	363	1	11	60.4	363	32.0	6.01
7miles " "	1182	3	16	87.8	394	73.9	13.47
Southwest Bank	883	3	17	88.0	294	53.5	10.04
Wolves Bank	3035	46	351	1513.5	66	8.3	1.93
441665	825	4	27	169.6	206	31.1	4.86
443663	67	2	18	93.3	34	3.8	0.72
444665	1895	17	58	370.4	111	22.2	3.47
444670	77	2	8	53.3	39	9.2	1.44

Table 17.- Fishery characteristics around Grand Manan Island by area in 1982.

Area	Catch	Effort			CPUE		
	kg	days	hours	hour-meters	kg/d	kg/h	kg/hm
Breaker	122	1	9	41.2	122	13.6	2.96
Bull Rock	2704	15	87	397.8	180	31.1	6.80
CrossJack Ledges	18	1	2	14.4	18	8.0	1.25
7miles " "	369	3	16	60.0	123	23.4	6.15
Dixon Rocks	271	2	11	48.0	136	25.8	5.65
Duck I. Sound	888	10	26	132.7	89	31.7	5.33
Grand Manan C.	74	3	10	57.6	25	7.4	1.28
Gannet Rock	3015	37	223	1030.4	81	13.2	2.86
3miles "	91	1	6	40.0	91	14.6	2.27
4miles "	30	1	2	8.6	30	13.3	3.50
7miles "	274	4	14	52.1	69	20.1	5.26
Ladders	499	3	4	22.6	166	55.1	10.05
Long Ledge	564	5	24	114.3	113	23.6	4.93
Murr Ledge	428	3	24	102.1	143	18.2	1.60
Prangle Point	520	5	34	216.0	104	15.4	2.41
Southeast Break	629	7	54	279.4	90	11.6	2.25
Southwest Head	181	1	6	32.9	181	30.2	5.50
St.Mary's Ledge	1140	9	56	254.9	127	20.5	4.47
Spruce Island	714	5	25	114.3	143	28.6	6.25
Southern Ledge Shoal	595	6	54	248.4	99	11.0	2.40
Tinker Shoal	1031	10	37	176.8	103	27.7	5.83
White Horse	237	3	5	26.8	79	18.9	3.76
West Isles	276	15	61	277.4	18	4.6	1.00
Western Ledge	258	2	8	34.7	129	32.3	7.44
Below Yellow Ledge	632	5	30	142.1	126	18.8	4.01
Yellow Ledge	181	1	3	17.3	181	57.5	10.47
442665	232	4	24	150.6	58	9.9	1.54
443665	30	1	3	16.0	30	12.0	1.87
Grand Manan offshore waters:							
Seal Island	1355	12	82	373.8	113	16.6	3.63
Wolves Bank	2691	40	312	1198.4	67	8.6	2.25
444665	1608	20	126	803.9	80	8.0	1.25

Table 18.- Fishery characteristics of Campobello and Deer Islands and Passamaquoddy Bay in 1981 and 1982.

Area	Catch	Effort			CPUE		
	kg	days	hours	hour-meters	kg/d	kg/h	kg/hm
1981							
Campobello I:							
Adams Island	106	4	14	89.6	27	7.6	1.18
Campobello I.	256	6	25	162.2	43	10.1	1.58
Herring Cove	665	15	81	516.1	44	8.2	1.29
Deer Island	242	6	36	218.2	40	6.6	1.11
Passamaquoddy:							
Eastern Bay	20	1	3	16.0	20	8.0	1.25
St. Andrews	1167	24	173	935.0	49	6.4	1.18
1982							
Campobello I:							
Herring Cove	426	11	72	394.7	39	6.0	1.08
Deer Island:							
Deer Island	54	1	6	29.0	54	8.5	1.86
Letete Passage	23	1	3	17.1	23	8.6	1.35
Passamaquoddy:							
Eastern Bay	44	2	6	38.4	22	7.3	1.15
St. Andrews	54	2	7	30.5	27	8.1	1.77

Table 19.- Percent of the total Class 1 catch and CPUE (kg/hm) from the ten most productive areas in 1981 and 1982 as reported in log records.

1981			1982		
Area	%	CPUE	Area	%	CPUE
Murr Ledge	10.54	8.08	Gannet Rock	13.25	2.86
White Ledge	7.47	14.56	Bull Rock	11.88	6.80
Southeast Break	6.45	7.25	Wolves Bank	11.82	2.25
Seal Island	6.21	6.67	444665	7.06	1.25
Wolves Bank	6.14	1.93	Seal Island	5.95	3.63
Bull Rock	4.93	8.71	St.Mary's Led	5.01	4.47
Yellow Ledge	4.79	6.63	Tinker Shoal	4.53	5.83
444665	3.83	3.47	Duck I. Sound	3.90	5.33
4miles Yellow L	3.66	9.26	Spruce I.	3.14	6.25
Grand Manan C.	3.59	1.29	Below Yellow L.	2.78	4.01
Totals	57.61	7.30*		69.32	3.98*

* weighted average by catch

Table 20.- Summary of fishery characteristics. Effort pertaining to logged catch and total offshore effort are prorated according to the effort which generated Class 1 catch. Prorating for total offshore effort is possible as only vessels greater than 25.5 G.T. provided log information.

	Catch		Effort			CPUE		
	kg	t	days	hours	hour-meters	kg/d	kg/h	kg/hm
1981								
Class 1 data	49468	49.47	416	2270	11588	119	21.8	4.27
All log data	52956	52.96	445	2430	12405			
Total offshore*		109.64	922	5031	25682			
1982								
Class 1 data	22763	22.76	258	1575	7584	88	14.5	3.00
All log data	24056	24.06	273	1664	8015			
Total offshore*		62.65	710	4335	20876			

* cf. Table 11.

Composition of the catch

Formal sampling of the catch has never been carried out. However, informal reports from fishery officers and data collection (shell samples from the catch) are available on an irregular basis. When the fishery took off in nearshore waters off Prangle Point in December 1979, there are reports that most of the scallops fished were in the 90-95 mm shell height class with an equivalent 42-44 meats per 500 g (estimated mean meat weight, 11.6 g). In the spring, when emphasis shifted to scallop beds off Seal Island and Southwest Bank, scallops were thin shelled (80-85 mm) and meats small (55-66 meats per 500 g).

At the peak of the fishery in early summer 1981 (May-June) samples of shells (discards from shucking operations) were collected from fishing boats operating in different areas (inshore except for Southwest Bank). There is a disparity in the size distribution of scallops caught at different locations over the very short time span (Fig. 3). Scallops larger than 100-mm shell height were fished 7 miles southwest of Gannet Rock, but in the immediate vicinity of Gannet Rock the bulk of the catch was made up of much smaller scallops, 75-90 mm. The May 27, 1981, sample meat count was 63 per 500 g. The catch from Southwest Bank was similar with a mode 80-90 mm shell height but a much higher count, 77 meats per 500 g. According to the growth curve parameters established earlier, age 4 scallops would have been the principal age-class represented in the catch from Gannet Rock. Farther away from Gannet Rock ages 6 and 7 scallops were also noticeable in the catch (sample dated 27/05/81).

By July 1982, with declining catch-rates (75-100 kg/d), the fleet was exploring further grounds; meat counts ranged between 23 and 39 per 500 g around Southeast Ledge. This would correspond to an estimated mean shell height of 105 mm and a mean meat weight of 16 g. By the end of the year counts were slightly higher (33-44 per 500 g) with little evidence of new scallops coming into the fishery. Most heavily exploited grounds were Gannet Rock and Duck Island Sound.

RESOURCE SURVEYS

Relative abundance of age-classes

Resource survey results have been post-stratified into two strata: 1) inside the 7-mile line; and 2) outside the 7-mile line for the time period for which data are available. This was done to relate to the exploitation strategy now in effect, i.e. seasonal dragging of scallop beds alternating inside and outside of 7 miles from the Grand Manan shoreline. Besides, randomly catch-stratified survey design had only been possible for the two most recent years.

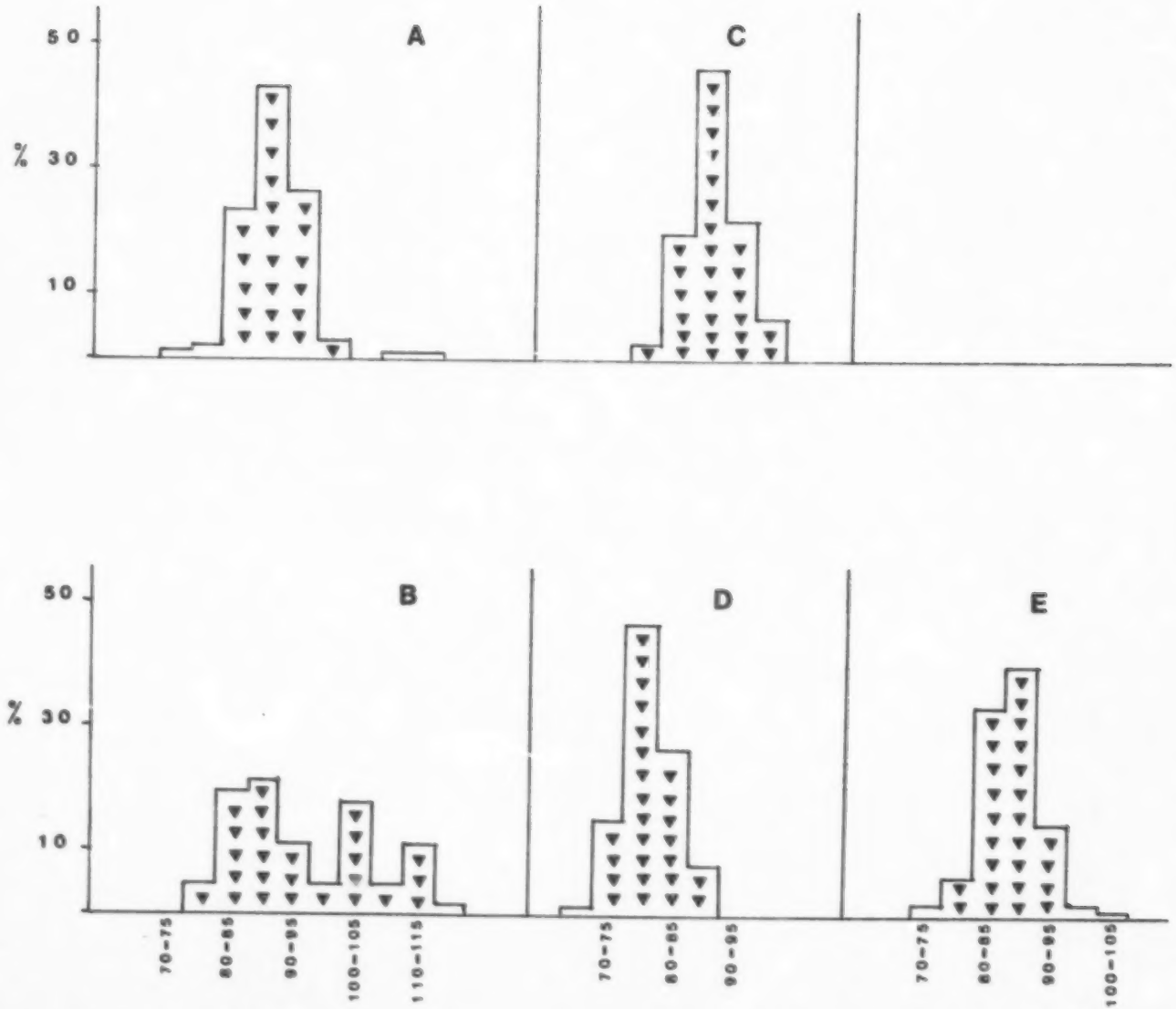

Figure 3.- Histograms of shell samples (shell height classes in mm) from fishing vessels operating in different areas near Grand Manan in 1981. A: Yellow Ledge, 300481; B: 7 miles southwest of Gannet Rock, 270581; C: Gannet Rock, 270581; D: Gannet Rock, 180681; E: Southwest Bank, 280581.

Summaries of annual survey results are presented in Table 21 and Figure 2. Throughout time, the inside 7-mile area has relatively more abundant stocks than the outside 7-mile area; the two areas follow generally similar trends. The average number of scallops per tow determined during the fall 1979 survey did not predict catches to come but then it was only exploratory in nature. However, 1980 and 1981 survey indices reflected the high catches, and 1982 results indicated a drop in scallop abundance. The average scallop catch at age per tow for a 4-gang Digby drag inside the 7-mile line shows a strong mode of age 4-5 scallops in 1979 which may be identified and followed throughout the survey years (Table 22). There were significantly fewer older scallops. Scallops younger than the age group making up the strong pulse were also much less important, except for a moderate peak of age 3 scallops in 1982. The outside 7-mile area also experienced high densities of a few year-classes, but they are not as distinct. Moreover, the outside area almost lacks older (age 8) scallops (110 mm). While prerecruits have remained at a stable level in the outside area since 1979, their density has gradually improved in the inside area even though prerecruit abundance is much less compared to recruits [relatively young recruits (4-7 yr) (Table 23)]. The most abundant recruit survey index refers to 1980 when high catches were recorded; 1981 and 1982 indices decrease somewhat.

Stock mortality rate estimates

Analysis of annual total mortality rates (Z) from the catch-at-age distribution of survey results was performed. A chi-square statistic verified that constant recruitment and annual survival rate could be assumed for all age groups entered in the catch vector. Vectors of annual catch numbers at age gave total mortality rate estimates. 1980 had the highest value (0.78), followed by 1981 (0.70) then by 1979 and 1982 (Table 24).

DISCUSSION

FISHERY DATA

The bulk of the recent record catches were landed by small inshore vessels ($\leq$25.5 G.T.). It is possible that actual landing figures may be much higher than the ones officially reported since about two-thirds of the scallop licenses are only casually involved in this fishery. One can safely assume that landings reported by statistical districts actually correspond to catches originating from local scallop beds. There is no advantage in landing elsewhere scallops caught in Grand Manan waters. Local ports of landings offer easy unloading and fresh catches bring good prices.

Table 21.- Number of research survey stations N by year and by area, average number of scallops per tow n (standard deviation) for unlined/lined gear.

Year	Inside 7-mile line		Outside 7-mile line		Total N
	N	n	N	n	
1979	21	82 (89)*	2	43*	23
1980	20	104(107)/57(79)**	6	218(308)/162(272)**	26
1981	55	72(72)/53(50)	31	51(59)/34(50)	86
		79(92)/62(60)		44(47)/32(43)	
1982	52	67(56)/49(65)	38	67(165)/47(63)	90
		61(57)/53(79)		47(64)/33(48)	

*in 1979, catches from unlined and lined gear were measured together.
**in 1980, catches of the drag of the same type (unlined vs. lined) were measured together.

Table 22.- Average scallop catch at age per tow for a 4-gang Digby drag inside the 7-mile line for lined middle buckets and unlined outside buckets. In 1979, catches from lined and unlined buckets were measured together.

Gear type and year	Age (yr)										
	1	2	3	4	5	6	7	8	9	10	11+
1979	0	0	4	18	16	7	5	3	2	2	2
Lined gear:											
1980	0	1	6	2	6	17	6	1	1	1	1
1981	0	2	5	4	6	11	10	4	2	1	1
1982	0	1	10	5	4	5	7	5	4	1	1
Unlined gear:											
1980	0	0	2	3	19	31	12	4	3	1	2
1981	0	0	0	2	11	20	17	6	2	1	1
1982	0	0	2	3	7	11	12	8	5	3	3

Table 23.- Average scallop catch per tow by age grouping in each area by year. Abundance of recruits (age 4+ years) was estimated from the catch of an unlined gear, while prerecruits (1-3 yr inclusive) abundance was estimated from the catch of a lined gear.

Year/Area	Prerecruits 1-3 yr	Recruits 4-7 yr	Recruits 8+ yr	Recruits total
1979				
Inside 7-mile line	4	46	8	54
Outside 7-mile line	2	19	0	19
1980				
Inside 7-mile line	8	66	10	76
Outside 7-mile line	2	180	0	180
1981				
Inside 7-mile line	6	49	11	60
Outside 7-mile line	1	25	4	29
1982				
Inside 7-mile line	10	31	19	50
Outside 7-mile line	2	35	6	41

Table 24.- Mortality (Z) rate estimates from the age distribution of survey results.

Year	Z	95 % confidence interval
1979	0.45	0.33 - 0.58
1980	0.78	0.56 - 1.00
1981	0.70	0.49 - 0.92
1982	0.46	0.32 - 0.61

To establish fishing characteristics of effort and catch-rates one has to rely on data from fishing logs which are less than 50% of the catches from offshore vessels (>25.5 G.T.). In turn, offshore catches make up only 20% of the total combined (inshore and offshore) catches. Until such time as effort data are available for the inshore component of the fleet, one has to cautiously assume that fishing patterns of both the inshore and offshore fleet are similar. Catch-rate expressed as kg per day is somewhat of a coarse-grained estimate, too general for any specific purpose; kg per hm is more representative, taking into account nature of the gear and towing time. With such an inshore type (proximity to sheltered waters) of scallop fishing, giving the same kind of effort rating to the variable "crew" could easily be misleading as "deck loading" is a common practice, especially in years of high stock abundance.

SURVEY DATA

Catch composition and location of most important commercial scallop beds match closely with stocks identified during the survey work. The most productive areas are usually very patchy, (easy to miss), and located alongside ledges and channels. The relatively small size, highly productive scallop beds of the inside 7-mile area had higher survey abundance indices. This was especially evident in waters south of Grand Manan. These in turn supported the highest catch levels. Survey coverage of the outside 7-mile area is not as extensive as the inside area due mainly to poor weather conditions. Inclement weather also limits fishing opportunities for the Grand Manan vessels. Therefore, neither landings nor survey indices may offer a valid representation of the scallop stocks of the outside 7-mile area. It is difficult to relate the catch-at-age vector from research cruises and the age composition of the commercial catch. The commercial data are too fragmentary. With closer monitoring it is possible that the strong recruiting pulse observed during research work would have been illustrated, much better perhaps, in samples from the fishing fleet.

Mortality rate estimates despite large 95% confidence intervals and origin from survey data give an approximation of fishing mortality rates. It is very likely that the 1981 rate is not high enough to match such extraordinary catch levels as those of 1981 plus the fact that fishing was expended on an accumulated biomass. Nevertheless a 1981 fishing mortality rate of the order of 0.6 is used in a yield-per-recruit computation. Natural mortality rate is commonly taken as 0.1 for recruited scallop stocks.

Since the conditions of constant recruitment and natural mortality rate are fulfilled as established by a chi-square statistic earlier, a Thompson and Bell yield-per-recruit model

(Ricker, 1975) was calculated using the allometric relationships, meat weight-shell height, and height-at-age for the inside and outside 7-mile areas respectively (Fig. 4 and 5). Meat count figures (number of scallop meats per 500 g) are presented in addition to g of meat per recruit as yield units as they are a common measure of performance. The inside area has higher yields than the outside area for similar F and age at recruitment. Shallow waters, higher biological productivity, and better seasonal temperature regime may all or in part favor the inside 7-mile area. For F>0.8 and age at first capture >7 yield is optimized at over 15 g per scallop in the inside 7-mile area while its optimum is decreased to over 13 g per scallop in the outside area.

According to the fragmentary data obtained from the fishing fleet, scallops would be fished before they reach a size of >100 mm shell height (age 7) either in the inside or outside area. The commercial shell height frequency samples and a F ranging from 0.4 to 0.7 would suggest a range of yield values barely reaching optimal conditions. Highly localized dense patches of scallops were found to be unimodal. It is usually the practice of Canadian fishermen to go for density of beds regardless of size distribution. Yield, hence fishing performance, may suffer in those cases even over the short term. For certain age classes it is possible to double the weight over one growing season. In all likelihood, mixing of small and large scallops was not too important (Fig. 3) in the exploitation of those stocks due to the strength of a single recruitment pulse compared to the vigor of previous and later year-classes.

CONCLUSIONS AND SUMMARY

1. Even though entry into the scallop fishery is limited there is a high number of scallop licenses, approximately 300, in southwest New Brunswick. Conservative estimates put at two-thirds the number of casual fishermen. Recently, inshore vessels (≤25.5 G.T.) have been responsible for the majority of landings; offshore vessels (>25.5 G.T.) have landed only 20% of the total catch. Catch data reported in fishing logs and accompanied by effort information totalled <50% of offshore catches. Therefore, it is particularly important to get a better idea of the participation rate and of the effort characteristics of inshore vessels. An improved log completion rate would also be an asset.

2. The scallop fishery in Grand Manan waters is of the inshore fishery type, part of a multispecies fishery pool. Up to recently, it was not very important with a 20-yr mean annual landing of 8.6 t of scallop meats. A strong recruiting year-class brought drastic changes to the fishery in 1980

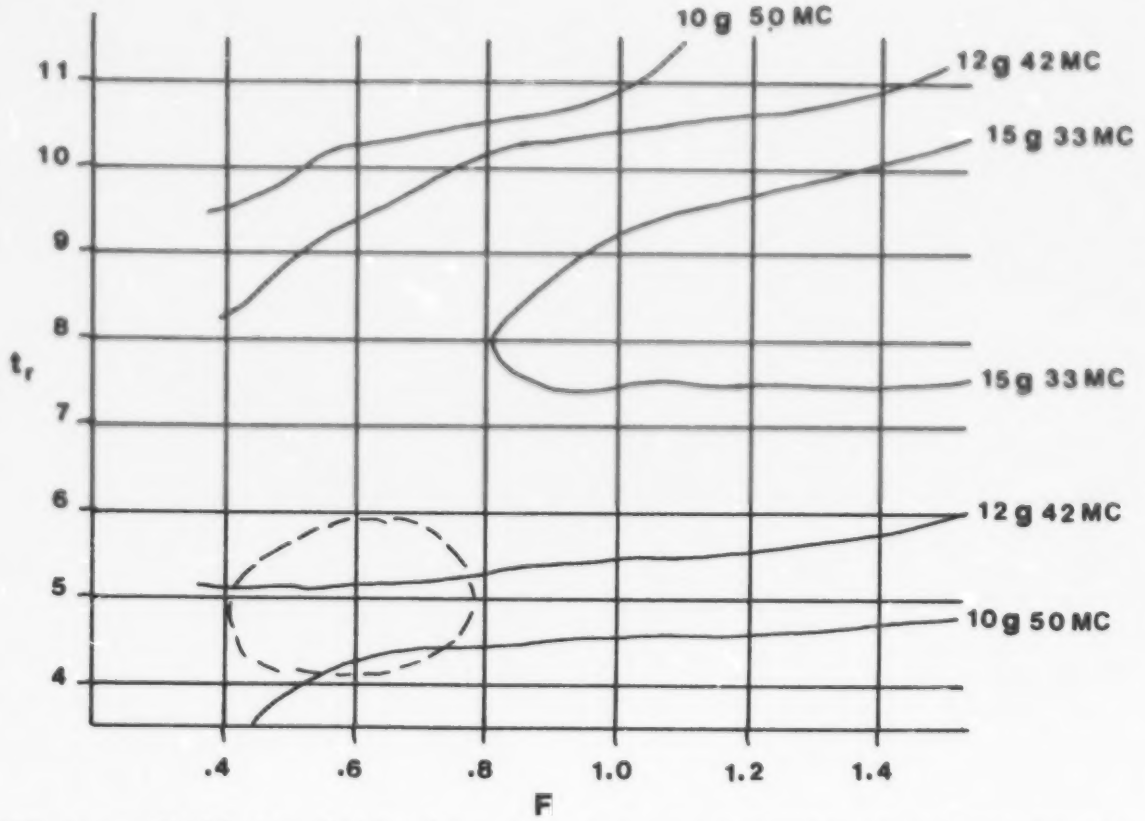

Figure 4.- Yield isopleths in g of meat per recruit according to the Thompson and Bell yield model for the area inside 7-mile with an oval of probable yield values in 1981.

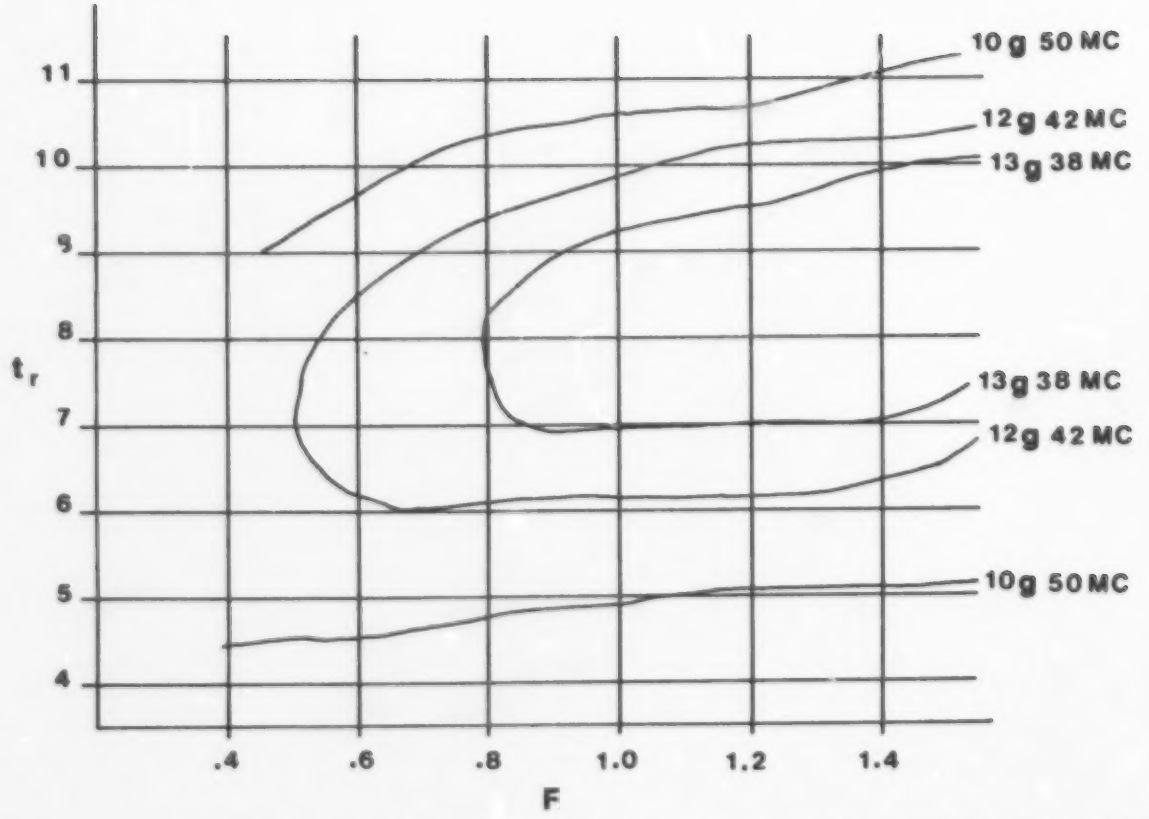

Figure 5.- Yield isopleths in g of meat per recruit according to the Thompson and Bell yield model for the area outside the 7-mile line.

with well above average landings for the area (164 t of meats). Landings peaked at 561 t in 1981 to decline slightly in 1982 (294 t).

3. Scallop beds immediately surrounding Grand Manan have supported and continued to support the bulk of the fishery and with the highest catch rates. An average 64% of the total Class 1 catch in 1981-82 came from the ten most productive areas, which makes for highly localized fishing. Average CPUE weighted by catch for those areas went from 7.30 to 3.98 kg/hm during that time period. Assuming similar fishing patterns for inshore and offshore vessels, total fishing effort estimated in days fished dropped by almost 30% from 1981 to 1982.

4. Resource surveys identified a strong recruiting pulse in 1979 (mode age 4-5) which is followed through in later surveys. It was mainly present within the boundaries of the 7-mile line. Survey annual abundance indices reflected catch levels. The 1982 index declined slightly as the strong pulse gets gradually depleted. Latest prerecruit indices are low and it is doubtful that the high catch levels experienced recently could be maintained.

5. According to annual mortality rates from catch-at-age distribution of survey results and assuming natural mortality rate at 0.1, fishing (F) mortality rate would range from 0.4 to 0.7. Fragmentary catch-at-age data from the fishery in 1981 indicate that the main shell height class fished was 85-90 mm corresponding to (young) age 5 scallops (meat weight approximately 11 g). Such yields are far less than optimal. Slightly greater fishing mortality rates (F>0.8) toward larger scallops (>age 7) would have far better yields both inside and outside the 7-mile line.

ACKNOWLEDGEMENTS

We thank the captain and crew of M.V. J.L. Hart for their dedication and professionalism; and Drs. Christopher M. Hawkins and Robert K. Mohn for reviewing the manuscript.

REFERENCES

Campbell, A. and D.R. Duggan. 1980. Review of the Grand Manan lobster fishery with an analysis of recent catch and effort trends. Can. Tech. Rep. Fish. Aquat. Sci. 997: 20 p.

Ganong, W.F. 1889. The economic mollusca of Acadia. Bull. Nat. Soc. New Brunswick 8: 116 p.

Jamieson, G.S. and M.J. Lundy. 1979. Bay of Fundy scallop stock assessment - 1978. Fish. Mar. Serv. Tech. Rep. 915: 14 p.

Jamieson, G.S., N.B. Witherspoon, and M.J. Lundy. 1981. Assessment of Northumberland Strait scallop stocks - 1980. Can. Tech. Rep. Fish. Aquat. Sci. 1017: 44 p.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Board Can. Bull. 191: 382 p.

POOR

QUALITY

ORIGINAL